

Health Effects of Vinyl Chloride Monomer: An Annotated Literature Collection

by Helen Warren* and James Edward Huff*

Introduction

In January 1974, the report of the deaths of four workers in the vinyl chloride-poly(vinyl chloride) (VC-PVC) industry from rare angiosarcoma of the liver triggered one of the most intensive epidemiological and toxicological searches in the history of industrial medicine.

The monomer, vinyl chloride, $\text{CH}_2 = \text{CHCl}$, a colorless gas with a faintly sweet and pleasant odor, is presently produced at an annual rate of 5 billion pounds in the United States. First synthesized and investigated in Germany in 1835 by Regnault, VC did not enter the industrial category until World War II, when its polymerization capabilities were recognized and rapidly exploited. The polymer, PVC, a powdery white crystal first produced commercially in the United States in 1939, now forms the basis of a vast plastics industry with an average annual growth rate of 14%, a 1973 production level of over 4 billion pounds, and an employee roster of approximately 350,000 people.

The reactive monomer is suspected as the toxic agent and carcinogen. The point of greatest worker exposure is in the polymerization processes. Hand-cleaning of polymerization reactors was established as a causal factor when acroosteolysis, one of the symptoms of vinyl chloride disease, developed among reactor cleaners in the 1960s. Since that time the industry has sought to improve processes and curb losses of the monomer, but investigations

by the Environmental Protection Agency's (EPA) Task Force confirm that an excess of 200 million pounds of VC and over 50 million pounds of PVC are discharged into the environment each year. A document entitled, "Preliminary Assessment of the Environmental Problems Associated With Vinyl Chloride and Polyvinyl Chloride" by the EPA Task Force is included in the literature compilation.

On October 4, 1974 the Occupational Safety and Health Administration of the Department of Labor published a new Standard for Exposure to Vinyl Chloride which was to take effect January 1, 1975 but was postponed, pending appeal by the Society of Plastics Industry to the Supreme Court. It set an exposure limit of 1 ppm averaged over an 8-hr period with a ceiling of 5 ppm averaged over any period not exceeding 15 min. The Federal Register notice of this Standard includes the background of the problem, and carcinogenicity findings, as well as the scope and feasibility of the standard.

Literature

The literature on VC has proliferated rapidly as the concern and resources of science, medicine, labor, industry, and government have been mobilized to elucidate mechanisms of VC toxicity as well as real and potential exposure hazards. The scientific community is striving to formulate, in the context of vinyl chloride, an index to the risks inherent in an ever-widening circle of chemicals, industries, processes, and exposed populations.

Two major conferences have been held this past year: the New York Academy of Sciences'

* Biomedical Sciences Section, Information Center Complex, Information Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830.

"Toxicity of Vinyl Chloride-Polyvinyl Chloride" convened on May 10 and 11, 1974 with proceedings in Volume 246 of *Annals of the New York Academy of Sciences* and the National Institute of Environmental Health Sciences' "Public Health Implications of Components of Plastics Manufacture" on July 29-31, 1974 resulting in this Issue of *Environmental Health Perspectives*.

Our compilation of annotated literature references is directed toward the health aspects of vinyl chloride with a few key historical and analytical references included. Annotations were prepared from the published reports except for a few instances in which time did not allow their acquisition or translation; in these cases, the abstract source used is noted with the citation.

Until 1960 literature detailing the toxic effects of vinyl chloride was sparse; more recently, however, the number of published reports has risen sharply. This trend is noted in the selected reports of this compilation: 1835-1959 (125 years), 17 reports; 1960-1969 (10 years), 43 reports; 1970-1974 (5 years), 102 reports.

Major sources of references in the compilation include:

Abstracts of World Medicine, 41: (1967)-45: (1974)
Air Pollution Abstracts, 2(5): (1971)-5(6): (1974)
Biological Abstracts, 1: (1926)-58(12): (1974)
Chemical Abstracts, 21: (1927)-81(11): (1974)
Chemical Titles, No. 1-14 (1974)
Excerpta Medica, Section 16, Cancer, 25: and 26: (8) (1974)
Current Journals
MEDLINE Data System
TOXLINE Data System
Oak Ridge National Laboratory Data Systems

The reference collection has been made a part

of the data base holdings of the Oak Ridge National Laboratory's Information Center Complex and will be updated as the literature accumulates.

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